IMPERIAL BUREAU OF MYCOLOGY

THE EXPERIMENTAL AND INSTRUCTIONAL SUGAR FACTORY OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

Via colendi haud facilis.

Officially opened by Sir H. A. BYATT, K.C.M.G., Governor of Trinidad and Tobago, on the afternoon of Saturday, February 28, 1925

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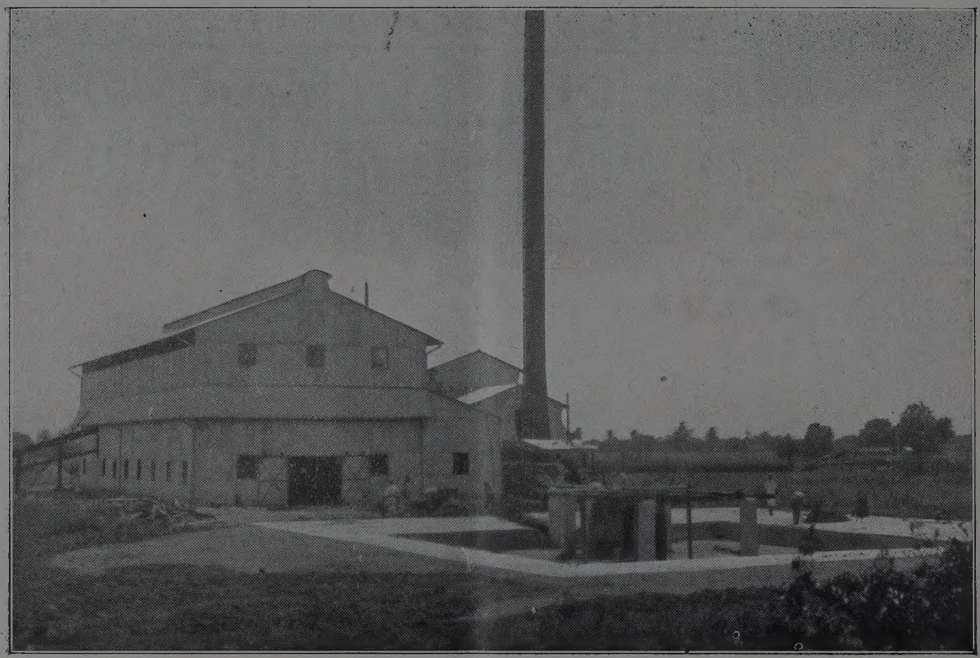

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THE INSTRUCTIONAL AND EXPERIMENTAL SUGAR FACTORY OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, AFTER THE DESIGN BY MR. C. BERTHON, A.M.I.C.E. ::

SUPPLEMENT TO

TROPICAL AGRICULTURE

THE OFFICIAL JOURNAL OF THE
IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

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THE INSTRUCTIONAL AND EXPERIMENTAL SUGAR FACTORY OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE.

(1) The History of the Factory.

By C. Y. Shephard, B.Sc. (Econ.)

The model and Experimental Sugar Factory of the Imperial College of Tropical Agriculture has entered upon its first crushing season and the result of the operations during 1925 will be awaited with considerable interest. The original idea must be attributed to the energy and foresight of Sir Francis Watts, K.C.M.G., D.Sc., our Principal Emeritus, whose interest in, and work on behalf of, the prosperity of the British Sugar Industry is universally recognised. It is a matter of deep regret that he was unable to be present at the official opening ceremony of the factory which owes its existence to his persistent efforts, but we are glad to record that his absence was due to the fact that, even in his retirement, his services have been requisitioned by the Secretary of State for the Colonies to report on methods for rehabilitating the fortunes of one of the distressed parts of the great Empire in whose service he has spent the whole of his active career.

The scheme for the erection of the model sugar factory was enthusiastically adopted by the Governing Body of the College and the services of an eminent expert, Mr. Claude Berthon, A.M.I.C.E., were secured to assist in the promotion of the scheme. This gentleman was instrumental in convening a meeting at the Royal Technical College, Glasgow, on June 14th, 1921, at which he and Sir Francis Watts explained the objects of the proposed Factory to an enthusiastic body of sugar machinery manufacturers and other interested gentlemen. It is a remarkable tribute to the generosity and far-sightedness of the British sugar machinery manufacturers that the meeting resulted in the promise of practically the whole of the equipment, to the value of £20,000, for the proposed factory. The result is that the model factory is equipped with a full complement of the latest types of sugar manufacturing machinery supplied by the world's finest manufacturers and is capable of manufacturing a very wide range of commercial sugars by the most modern processes.

Unfortunately a hiatus occurred. Faced with the difficulty of securing sufficient funds to complete the new buildings of the College and in the absence of what Mr. Fisher described as "a corps of well-trained millionaires," which appears to be at the command of every American University, the idea of the sugar factory had temporarily to be shelved. The planting community of the small Colony of Trinidad and Tobago, with unparalleled generosity, and in spite of the fact that the Colony is but slowly emerging from the trough of a profound trade depression, magnanimously urged upon its Government that a produce tax should be imposed upon agricultural exports with a view to raising approximately £50,000 in order that a beginning might be made to the permanent buildings designed by Major Corlette, O.B.E., F.S.A., F.R.I.B.A.

With funds for the College building assured by Trinidad and other Colonial Governments the idea of the sugar factory was resuscitated with renewed vigour, and events have since moved rapidly. Special recognition is due to Mr. Claude Berthon who is responsible for the

design of the factory and the co-ordination of the constituent elements of machinery. The whole of this arduous work has been performed by him in an honorary capacity as Consulting Engineer and all connected with the College are extremely grateful to him for the important services which he has rendered.

The factory was erected under the direction of Mr. G. Mayes who assisted Mr. Berthon in the design. Mr. Mayes now occupies an important position in the Basseterre Sugar Factory, St. Kitts. The factory will be operated under the direction of Mr. O. F. Boyd, Professor of Sugar Technology, son of Colonel Thomas D. Boyd, President of the Louisiana State University, to which is attached the Audubon Sugar School in which Professor Boyd was trained. The College Course in Sugar Technology and the machinery of the factory are fully described by Professor Boyd in the two succeeding articles.

The model experimental Sugar Factory of the Imperial College of Tropical Agriculture is the first of its kind to be erected in the British Empire, although pride of place must be yielded to America, where the Audubon Sugar School of the Louisiana State University was the first instructional and experimental sugar factory in the world. Astonishing claims are advanced on behalf of this School and it is earnestly hoped that when the Sugar Factory of the Imperial College of Tropical Agriculture can boast of the same ripe experience she will be able to advance equally ambitious claims.

There has recently been a strong revival of interest in the production of sugar in the British Empire. The sugar industry has always been the plaything of legislators and ministers of finance, and sugar is at present one of the world's most universally taxed commodities, and a number of foreign countries, particularly the United States of America and Continental countries, have skilfully adopted their tariff to foster the industry either within their own territories or in those of their 'financial' colonies. The British Sugar Industry has been cursed, rather than blessed, with a surfeit of legislation, and the inconsistency of policy of successive ministries has had a most demoralising effect upon the industry as a whole. It is to be hoped that the recent legislation for the encouraging of both the beet and cane sugar industry in the British Empire marks the end of this weathervane legislation. The Empire is capable of producing a supply of sugar entirely adequate for its needs and there is no reason why, with favourable legislation, the Empire should not become entirely independent of foreign supplies.

It is eminently fitting that the completion of the Sugar Factory of the Imperial College of Tropical Agriculture should coincide with this revival of interest, since the College possesses adequate facilities for the training of sugar technologists in every branch of factory control. One thing only is lacking, namely, an estate of a size commensurate with the needs of the Sugar Factory for sugar cane, and, in addition, the other tropical crops for the training in the cultivation of which the College offers unique facilities. The College lacks even an adequate area for the cultivation of sugar cane upon an experimental scale, but it is essential, if the College is to fulfil its Imperial aim, that it should be in a position to offer equal facilities for the technical training in the cultivation of the sugar cane. The relation between the estate and the factory should be of a highly intimate nature. The College is fortunate in being situated in an area abounding with large scale estates whose proprietors and managers have generously offered facilities for study to the staff and students of the College, but admirable though they are, they form no substitute for the knowledge and confidence which can be obtained only from a practical handling of men and an intimate contact with the problems which confront every sugar estate manager in the tropics. The acquisition of this estate, which would be of an essentially reproductive nature, is a part of the accepted policy of the College, but the idea languishes through the lack of adequate ways and means. It may be that the generosity of those interested in Empire development will afford us facilities to justify ourselves. "*Via colendi haud facilis.*"

THE INSTRUCTIONAL AND EXPERIMENTAL SUGAR FACTORY OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE.

(2) The College Course in Sugar Technology.

By Professor O. F. Boyd, B.A. (University of La.)

It will be generally agreed that the Imperial College of Tropical Agriculture, in establishing a course in Sugar Technology has done a very wise and helpful thing for the West Indies, and the sugar producing world at large. There are only two or three sugar schools in the world where one can receive specialised training in sugar technology, and there is always a great demand for trained sugar technologists and specialists. Scientific production has been sadly lacking in the past in cane sugar manufacture, and it is not to be compared with the strict chemical and technical control in use in beet sugar factories.

The world's supply and demand of sugar is constantly increasing and although they may fluctuate yearly slightly, the production has been on the upward trend for the past thirty years. The importance of a scientific, technical and chemical control of the factory and field work is being recognised and acknowledged more and more every year. The old slipshod methods of "rule of thumb" are being cast aside for the more modern methods of chemical control and scientific cultivation.

The purpose of the College course in Sugar Technology, which will be pursued this year for the first time, is to train technologists in the manufacture of sugar in all of its various phases, and to give them a thorough practical and theoretical knowledge of the principal processes of fabrication. To this end, the College has been fortunate enough to secure an appropriation for an experimental factory, which is erected on the College grounds, and the factory will be in actual operation this coming grinding season. It has been so designed and erected that numerous experiments are possible. Various processes and methods can be carried out without any material alteration being made in the machinery. The capacity of the various units in their relation to the milling capacity are sufficiently large to allow extreme flexibility in the various processes of manufacture. The desirability of this condition is obvious. The factory can be converted into one of almost any type within a reasonably short length of time, and hence the type or grade of sugar being manufactured can be altered at will. Arrangements have been made to convert the factory into a small refinery and thus enable it to refine part, or all, of its own raw sugar. The machinery is of the latest type, and is partly a gift of the various manufacturers of sugar machinery in Great Britain. The building is of steel construction and fireproof.

The magnificent opportunities for actual practical experimental work are easily recognised, and it will be the aim and purpose of this department to take advantage of them.

A complete course of lectures on sugar manufacture in all of its various phases, will be given. The various processes for manufacturing the different grades will be described and studied, and arguments presented as to their merits and demerits. As the lectures upon the manufacture of sugar in its various phases and processes are given, their practical accomplishment must be carried out simultaneously in the factory and analyses made in the laboratory of the juices, syrups, molasses, &c., and a complete routine established. In this way an actual demonstration of the process accompanies the lecture and laboratory work. It will be the aim of this department to combine as much as possible the theoretical and the practical side which in turn will make an understanding of either feature infinitely simpler.

This plan will obviously offer numerous opportunities for study and research. It is the intention of this department to use every process possible and to keep a strict chemical control on the factory at all times, so that various comparative data may be obtained. The laboratory work will be conducted exactly as it is done in a larger factory working on a commercial basis, and a close check kept upon losses and yields. A system of sugar factory bookkeeping and report work will be installed similar to those in use in the most modern factories to-day. For the present it will only be possible to instal a very small factory laboratory and this room will be used for controlling acidities and alkalinities. The analysis and routine work will take place in the laboratory in the College building, which has been especially equipped for that purpose.

The construction of the machinery and the elementary principles under which the various units operate will be treated under a course in "Chemical Machinery." This course will be required of both second and third year students. A study of the principles of boiler construction, steam, horsepower, heat units, &c., will be included in this subject. Comparative fuel values, and fuel economy of various processes is an important line of study in any industry and this will be introduced into this course.

The Agricultural Engineering Course will be partly taught by the Agronomy department. It

will consist of a series of lectures on the use of farm implements, tractors, haulage, irrigation and drainage problems.

A two-year course in Spanish will be offered to students of Sugar Technology and will be compulsory. The course will be open to any student who has reached the second year. The importance of a speaking knowledge of Spanish to one engaged in any phase of the sugar industry is quite manifest. It is practically essential that factory superintendents, engineers and chemists, engaged in the industry in Spanish speaking countries, be able to speak the language. Students will be also encouraged to obtain if possible a working knowledge of Dutch. And as soon as one who intends to follow sugar work begins to study the elements of the language, the quicker and more readily is a speaking knowledge acquired. Nearly 50 per cent. of the world's sugar supply is manufactured in Spanish speaking countries, and in Cuba alone, over four million long tons will be produced this year. One who is to be trained in sugar technology cannot therefore expect to have completed his training without a knowledge of the above languages spoken in the largest sugar-producing countries. The importance of a working knowledge of these foreign languages is often overlooked in respect of other branches of tropical agricultural science, and their inclusion in the curriculum is likely to serve a generally useful purpose in the College instruction.

The micro-biology and the study of the fermentation of molasses will be taken up by the micro-biological department. This knowledge is very necessary as numerous distilleries are run in conjunction with factories, utilising the waste molasses for the manufacture of alcohol and rum.

The economic and accounting phase of the industry will be gone into by the economics department, and statistics will be furnished of yields and losses by this department. In this manner estimates of the comparative costs of production expended in various processes can be arrived at, and statistics compiled.

In summarising briefly the foregoing :—the objects and purposes of the course are to furnish theoretical and practical instruction in the manufacture of sugar. This instruction is to be accompanied by practical factory and laboratory demonstrations, and by operating the experimental factory under the same conditions as a larger factory would operate upon a commercial basis, especially in regard to labour and fuel. The results obtained from experimental demonstrations would therefore be comparable with those in a parallel case in a larger factory.

The opportunities for research work and investigations of various conditions in the factory are manifold, and every encouragement and co-operation will be offered to anyone, not connected with the college who is interested in any phase of the manufacture of sugar and cares to go into any of its numerous problems.

It is the intention of this department to give lectures frequently upon various subjects of interest to those connected with the industry. The public will be invited to attend these lectures, and it is hoped that estate owners, engineers, chemists, overseers, pan-boilers, and anyone in the least interested will do so.

A thorough co-operation with the local factories will be undertaken and a study of local conditions made, with a view to building up a feeling of co-operation which will tend towards helping the students, the staff, and those connected with the industry to a possible solution of problems, with a mutual benefit to all.

THE INSTRUCTIONAL AND EXPERIMENTAL SUGAR FACTORY OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE.

(3) Description of the Machinery.

By Professor O. F. Boyd, B.A. (University of La.)

The experimental sugar factory which is now being erected upon the grounds of the Imperial College of Tropical Agriculture is rapidly nearing completion, and actual manufacturing operations or crushing will begin the first week in March.

The local department of Agriculture has very kindly consented to furnish about two thousand tons of canes for the factory. These canes are of numerous varieties and will give an opportunity for observing the milling and factory conditions as they vary with the different types. Although not entirely a gift, the supply of canes will be partly so. It is the intention this year to try and make the factory pay financially, that is to clear enough from the sale of the sugar and molasses to pay the actual operating expenses, and with this end in view, very little change will be made in the type of sugar manufactured. Yellow crystals will in all probability be the principal grade of sugar to be produced—because of the good market here for that particular type.

The idea of the Experimental factory was perhaps originally that of Sir Francis Watts, and although its erection was discussed for years, and appeals for money made, it was not until the past year that the actual building operations began, and a department of Sugar Technology in the Imperial College of Tropical Agriculture was established. The equipment and machinery in the factory is largely a gift of the various manufacturers of Sugar Factory Machinery throughout Great Britain and it is mainly through their generosity and kindness that the erection of the factory was made possible.

Most of the other large mills evaporator, &c., units are entirely the gifts of their producers, but in some cases the unit is only partly a gift inasmuch as a substantial reduction in price has been allowed.

As the cane enters the factory yard it is weighed on a weigh bridge which is a gift of Henry Pooley & Son Ltd. The scale beam and operating section are enclosed in a small house so as to protect the operator from the weather. The cane will be transferred to the cane carrier by hand, and thence to the mills where it is crushed and the juice extracted.

The entire milling plant consists of the cane carrier, an eleven roll mill, and megass elevator, all of which are driven by one steam engine. The entire plant was furnished by Mirrlees Watson & Co., Ltd. as a gift to the College. The mills are of sufficient capacity to crush two or three tons of cane an hour and are 16 inches × 21 inches. The driving engine is fitted with a link-reversing gear so that the rolls can be reversed if the occasion should arise. A very unique megass weighing machine has also been installed, so that an accurate check can be kept on milling operations, as well as fuel and boiler problems. This weighing device is the gift of S. Denison & Co., Ltd. and is perhaps the only one of its kind in existence.

After the mixed or dilute juice has left the mills it is pumped to a nest of tanks almost at the top of the building. From these tanks it is drawn into large pivoted tins set upon a scale, where it is weighed. These weighing machines are so hinged that they can be tipped over and the juice discharged into similar nest of tanks just underneath the top nest. The weighing machines are the gift of W. & T. Avery, Ltd.

After the raw juice has been weighed and discharged from the weighing machines into the lower tanks, the process of clarification is ready to be started. Almost any type of clarifying can be carried out, and changes made in the process at any time. This is made possible by the extreme flexibility of the arrangement of the pipe lines, and the large capacity of the other units in proportion to that of the mills. The piping is so installed that the flow of the juice can be sent in almost any direction, to conform with the necessities of the particular methods of manufacture in use. As it is obviously impossible to describe in this space more than one process, an effort will be made to outline the manufacture of plantation white sugar, and to follow the flow of the various juices, syrups, and molasses throughout this process, mentioning and describing the different units used in the above named method.

The juice upon leaving the lower nest of receiving tanks can be saturated with sulphur dioxide either in a sulphur tower, or in a sulphitor, and thence pumped to the liming tanks, where milk of lime is added until the required acidity is reached. The treated juice is now pumped through the juice heaters, one of which is a high velocity heater, and the other a low one. These are the gifts of A. F. Craig & Co., and can be used either as separate units or in series. The heated liquor is allowed to subside or defecate in open subsiders, the clear juice drawn off and sent to the evaporator charge tank, and the scums retreated and allowed to settle again in the second

subsiders, the clear juice is again drawn off and sent to the evaporator charge tank, and the scums to the filter press charge tank.

The scums are treated in the usual way limed and boiled, and filtered through plate and frame presses. The presses have been presented to the College by S. H. Johnson & Co., Ltd. together with a three throw pump, and the charging and receiving tanks. Two of the presses are to be used for filtering juice scums, while the third may be used either for juice scums or syrups. S. H. Johnson & Co., Ltd., have also furnished, as a gift, a small gravity filter of the Phillipe type for the filtration of the syrup together with the necessary charging and receiving tank.

The filtered juice can either be mixed indirectly into the clarified juice going to the evaporators or if too highly alkaline it can be returned to the liming tanks and sent through the process again.

The main body of the clarified juice is now ready for the evaporation process. The evaporator is a triple effect presented by the Harvey Engineering Co., Ltd. and has 700 square feet heating surface. It is mounted upon staging also furnished by the above firm.

The vacuum engine or pump has been presented by George Fletcher & Co., Ltd. along with two surface condensers, one of which is connected to the pan the other to the triple effect. The pump serves the purpose of producing vacuum for both the pan and the triple and is connected to both condensers. The valves are so arranged that either unit can be cut out of service when necessary. The circulation water pump is the centrifugal type motor driven, and was a gift of Drysdale Co., Ltd.

The concentrated thick juice or syrup, after leaving the evaporators may be treated in numerous different ways due to the flexibility of the arrangement of the piping and the apparatus. In this process, however, for plantation whites, it will be re-sulphured and filtered through the gravity filter described above and sent to the pan charging tanks, and concentrated to sugar. It will be unnecessary to describe the various methods of boiling and of pan work in use in manufacture of plantation whites, but it will suffice to say that the method best adopted to the local conditions will be sought for and adopted.

A three coil vacuum pan was furnished as a gift by A. & W. Smith, and has a capacity of 50 cubic feet. It is of the most modern type and equipped with the necessary accessories including a cup for seeding or shock graining. Beneath the pan are three water and steam jacketed crystallizers of the open type of about 55 cubic feet capacity, and below these is the mixer, these units have been given by Watson, Laidlow & Co., Ltd. and Potts, Cassels & Williamson have donated the two centrifugals just beneath the mixer. The massecuite can be discharged directly into the mixer or into the crystallizer, and the mixer is divided into two compartments to facilitate the separation of first and second sugars. There has been no provision made for a granulator but it is to be hoped that in the future one might be secured so that plantation granulated sugar could be manufactured.

The sugar store is just adjoining the centrifugals and the necessary scales and bagging equipment has been provided. The water supply comes from two Artesian wells both connected to a deep well pump given by Worthington-Simpson, Ltd.

The boiler has been donated by Babcock & Wilcox Co., Ltd. and is of the water tubular type. It has approximately 1,800 square feet of heating surface, and is equipped with all the necessary appliances, including a safety high and low water alarm. The boiler mountings are the gift of J. Hopkinson & Co., Ltd. and include fire bricks.

The boiler feed pump is of the Weir type and was donated by the G. & J. Weir, Ltd. Between the boiler and the chimney is a Green's Fuel Economizer which has been presented by its manufacturers, Messrs. E. Green & Son, Ltd. It is for the purpose of heating the boiler feed water by means of the flue gases. Motor driven scrapers keep the tubes clean and prevent incrustations of soot and ashes. The Economizer can be removed from service by means of two dampers which deflect the gases through a by-pass directly up the chimney.

Either oil or megass may be used as fuel in the boiler, and the oil equipment has also been presented by Babcock & Wilcox Co., Ltd. It consists of a pump and pre-heater and a patented nozzle for oil burning of their own design.

Practically all of the pumps are motor driven and the electrical equipment consists of eleven motors and control gears, a main dynamo, and a smaller dynamo driven by a Petter engine.

The eleven crude oil motors are gifts of the British Thompson, Houston Co., and are mainly used for driving pumps throughout the factory. The small generator and crude oil engine will be used for lights when there is no steam in the building, also to turn over the crystallizer shafts, week-ends.

Joseph Evans & Sons have given several three throw pumps for the juice, and other donations, include an air compressor—given by the Usine Sainte Madeleine Co., Ltd., a local sugar factory—two reducing valves by David, Auld & Sons, Ltd. Three reducing valves by Sir W. H. Bailey & Co., and an oil separator by Baker, Ltd. Several valves were presented by Glenfield & Kennedy, Ltd. and two Auto-dischargers for the two surface condensers were given by Holden & Brooke, Ltd.

The factory is now practically complete, all of the machinery has arrived, with the exception of two tanks, which are en route now. The plan is to start grinding in March and grind two thousand tons of cane, and an attempt will be made to make a profit off the sugar sold.

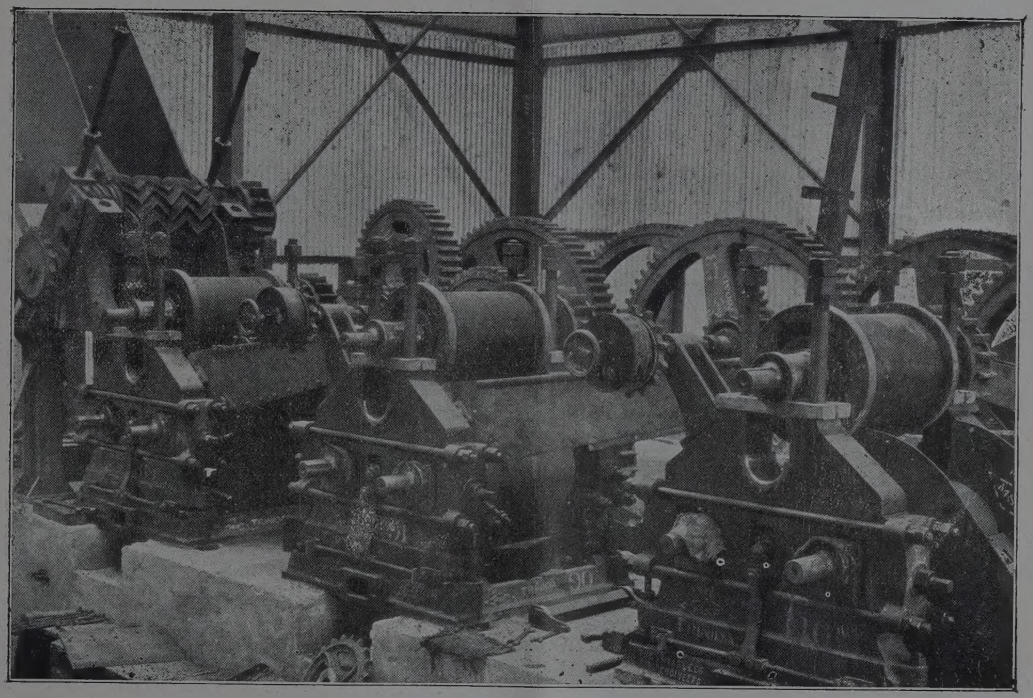
The designing and plans for the factory were done by Mr. C. T. Berthon, who performed this service as a gift to the College.

THE INSTRUCTIONAL AND EXPERIMENTAL SUGAR FACTORY OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE.

(4) First list of Presentations.

[*The following is the first list of presentations towards the Experimental and Instructional Sugar Factory of the Imperial College of Tropical Agriculture. Later contributions will be published in subsequent issues of "Tropical Agriculture."*]

Boiler (Water Tube)	BABCOCK & WILCOX, LTD.
Boiler Mountings	J. HOPKINSON & CO., LTD.
Fuel Economiser	E. GREEN & SON, LTD.
Boiler Feed Pump	G. & J. WEIR, LTD.
Mill Plant (11-Roller) and Multijector Air Pump ..	THE MIRRLEES WATSON CO., LTD.
Juice Heaters (two)	A. F. CRAIG & CO., LTD.
Eliminators (two)	FAWCETT, PRESTON & CO., LTD.
Triple Effect Evaporator and Staging	THE HARVEY ENGINEERING CO., LTD.
Filter Presses (three), Gravity Filter, Tanks and Three-Throw Pump	S. H. JOHNSON, & CO., LTD.
Vacuum Pan and Staging	A. & W. SMITH & CO., LTD.
Condensers (Surface), (two), Vacuum Pumping Engine	GEORGE FLETCHER & CO., LTD.
Crystallisers (three), Strike Mixer	WATSON, LAIDLAW. & CO., LTD.
Centrifugals (two) and Accessories	POTT, CASSELS & WILLIAMSON.
Engine for Driving Main Dynamo	BELLISS & MORCOM, LTD.
Electric Motors (eleven) and Control Gear ..	THE BRITISH THOMSON-HOUSTON CO., LTD.
Centrifugal Pump for Condenser Water ..	DRYSDALE & CO., LTD.
Centrifugal Pump for General Service Water ..	WORTHINGTON-SIMPSON, LTD.
Air Compressor	THE SAINTE MADELEINE SUGAR CO., LTD.
Pump (three-throw) for Juice	JOSEPH EVANS & SONS, LTD.
Reducing Valves (two)	DAVID AULD & SONS, LTD.
Reducing Valves (three)	SIR W. H. BAILEY & CO., LTD.
Oil Separators	BAKERS (LEEDS), LTD.
Auto-Discharges (two) for Condensers	HOLDEN & BROOKE, LTD.
Valves	GLENFIELD & KENNEDY, LTD.
Weighing Machines for Liquids (three)	W. & T. AVERY, LTD.
Weighing Machine for Megass	S. DENISON & SONS, LTD.
Weighing Machine	HENRY POOLEY & SON, LTD.
Donation towards Equipment	DONALD CLERK & SON, LTD.
Juice Receiving Tank	MILLEN BROS.
Copper Pipes	YORKSHIRE COPPER WORKS, LTD.
Do.	ALLEN EVERITT & SONS, LTD.
Do.	BROUGHTON COPPER CO., LTD.
Steel Exhaust Steam Piping	STEWARTS & LLOYDS, LTD.
Miscellaneous Cast Iron Piping	SHAW GLASCOW, LTD.
Bolts and Nuts	D. WILLETTS, LTD. & J. M. MITCHELL.
Miscellaneous Wrought Iron Piping	NORMAN PEARSON & CO.,LTD.
Sugar Melting Pan	DUNCAN STEWART & CO., LTD.



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